

Concussed or Not? An Assessment of Concussion Experience and Knowledge Within Elite and Semiprofessional Rugby Union

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Objective: The primary aim was to assess experience and knowledge of adult concussion among international, professional and semiprofessional players, coaches, medical staff, and referees within Rugby Union. The secondary aim was to identify preferred education dissemination routes.

Design: Questionnaires devised specifically for players, coaches, medical staff, and referees.

Setting and Participants: A total of 370 players, 44 coaches, 40 medical staff, and 33 referees from within Wales were surveyed.

Main Outcome Measures: Knowledge of the signs and symptoms of concussion, return to play guidelines and consequences of concussion were investigated along with experiences of, and attitudes towards, concussion.

Results: The respondents had extensive experience of sustaining or witnessing rugby-related concussion. Medical staff had the greatest level of concussion knowledge, with coaches having the least. Players and coaches exhibited a disconnection between being “knocked-out” and practically applying this when managing concussion. Almost half of the players and coaches did not indicate concussion could impair performance. Eighty percent of medical staff had felt pressured to clear a concussed player. Most players (82%), coaches (66%), and referees (64%) incorrectly believed protective equipment prevents concussion. Players and coaches prefer concussion education from medical staff, whereas medical staff and referees prefer such education from governing body Web sites or training courses.

Conclusions: Several role-specific misconceptions and deficiencies in concussion knowledge were identified and should be targeted through education. Medical staff had the highest level of concussion knowledge and were the preferred sources of education for players and coaches. Therefore, they are encouraged to play a greater role in providing concussion education.

Key Words: brain concussion, head injury, signs and symptoms of concussion

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INTRODUCTION

The most recent concussion in sport consensus statement defines concussion as “...a complex pathophysiological process affecting the brain, induced by biomechanical forces.” It can be caused by either direct or indirect force that temporarily impairs brain function.¹ Concussion has historically been viewed as a functional brain injury; however, new investigations suggest that transient and permanent structural damage may also occur.^{2–4} Although concussion is not a new problem within contact sports, the process of identification, evaluation, management, and return to play of concussed athletes remains challenging and controversial.⁵

Several sports (eg Rugby Union, Rugby League, and Australian Rules Football) have a high incidence of concussion as they involve frequent, forceful body contact between players.⁶ Rugby Union, often seen as a “collision” sport, has published concussion rates of between 4.5 and 9 concussions per 1000 match hours.^{6–9} However, it has been argued that concussion rates are underreported, possibly because of factors such as a lack of knowledge and pressures to continue to play.^{10–12} This is evidenced by an increase in concussion reporting rates following formal trials of a World Rugby (the international Rugby Union governing body) protocol, the Pitch-Side Concussion Assessment, which aimed to aid in the management of head impact events that had the potential for concussion.^{9,13,14}

World Rugby provides concussion management guidelines stating that any player showing the signs and symptoms of concussion should be immediately removed from the field of play or practice. Players should not return to play or practice on the same day, and review by a medical practitioner is recommended. Concussed players should undertake a period of cognitive and physical rest until all signs and

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symptoms are resolved. A graduated return to play (GRTP) that follows World Rugby and National Rugby Union guidelines should ensue.^{15,16}

Although previous research has assessed concussion knowledge of players, coaches, medical staff, and parents in a variety of sports (eg Rugby Union and League, ice hockey, soccer, Australian football), at differing levels (eg amateur, community, U20 s, youth academy, high school), and within several countries (eg Australia, Canada, Italy, New Zealand, and the United States),^{10,17–25} no research has been performed within the United Kingdom, nor at the elite level of Rugby Union. Furthermore, there are no publications comprehensively investigating concussion knowledge of the key player welfare stakeholders, including other players, medical staff, coaches, and referees. This information is vital to not only establish a current level of knowledge but also to inform the content and delivery of future concussion recognition and management education programs. Knowledge dissemination is an important component of behavior change theory.²⁶ To date, World Rugby and other National Governing bodies have promoted and disseminated their concussion education through web-based and hard copy.^{15,16,27} Although these guidelines have been extensively promoted, the level of knowledge transfer, and potential behavior modification to those within the Rugby Union is currently unknown. Therefore, the primary aim of this study was to assess the concussion experiences and level of concussion knowledge among adult professional and semiprofessional Rugby Union players, medical staff, coaches, and referees. The secondary aim was to identify preferred knowledge dissemination routes.

METHODS

Players, coaches, and medical staff (doctors, physiotherapists, rehabilitation therapists, and first aiders) from the four professional men's rugby teams and all 12 of the semiprofessional men's teams within Wales were invited to participate. Additionally, the players, coaches, and medical staff from the Wales men's, women's, and under 20's national teams were invited to participate. Within this cohort, there were a total of approximately 635 registered players, 62 coaches, and 52 medical staff. All elite referees ($n = 33$) registered within Wales to referee at either professional or semiprofessional levels were also invited to participate. Ethical approval for this study was obtained from Cardiff University Bioscience School Research Ethics Committee.

Role-specific questionnaires were developed to evaluate player, coach, medical staff, and referee personal experience, attitudes to, and knowledge of, concussion (see **Questionnaires, Supplemental Digital Contents 1–4**, <http://links.lww.com/JSM/A77>; <http://links.lww.com/JSM/A78>; <http://links.lww.com/JSM/A79>; <http://links.lww.com/JSM/A80>, which shows each role-specific questionnaire in full). Each of the 4 questionnaires were developed during round-table discussions with experienced medical practitioners (P.M., C.R., and R.M.) working within the Rugby Union. They were then piloted to ensure face, and content validity, particularly to confirm that key areas of the latest international consensus on concussion in sport¹ and World Rugby guidelines²⁷ were incorporated. Questionnaires were administered as a Welsh

Rugby Union directive, requesting completion by all relevant staff and players. Teams were either visited directly by one of the researchers (D.E.), or questionnaires were distributed, completed, and returned by the team's medical staff. Referees were located over a wide geographical area and therefore electronically received and returned their questionnaire.

Each role-specific questionnaire included the following sections: participant demographics, concussion symptom recognition, personal experiences and attitudes toward concussion, return to play, consequences of concussion, and concussion education. The number of questions within each section of the questionnaires varied to accommodate for role specificity. This meant the questionnaire for the players constituted 27 questions, for the coaches 33 questions, for the medical staff 35 questions, and for the referees 27 questions.

To assess concussion symptom recognition, a list of possible physical, cognitive and emotional signs and symptoms was devised. This included the 10 most common signs and symptoms of concussion^{28–30} and 10 distractor symptoms. An additional question (Do you have to be 'knocked-out' to be concussed?) was included in this section. All items and questions were scored on dichotomous "yes" or "no" scales. Correct answers were given a score of 1, with this being either yes or no depending on whether the symptom was true or a distractor. Therefore, the total concussion symptom recognition (CSr) score was 21, with higher scores indicating better knowledge.

Questions relating to return to play were used to assess knowledge of the current Welsh Rugby Union GRTP guidelines. Questions regarding actions that may slow a person's recovery from concussion were also included. All questions within this section were of multiple choice, with one question requiring multiple answers. The total return to play knowledge (RTPk) score was 14, again with higher scores indicating better knowledge. As referees have minimal exposure to the GRTP process, and do not usually contribute to a player's welfare during this phase of recovery, they were not included in RTPk analysis.

Three questions were utilized to assess consequences of concussion knowledge (CCk); the consequences of returning to sport when concussed, the potential long-term risks of repeated concussion and whether protective equipment could help prevent concussion. All questions within this section had the option for multiple answers to be selected. The total CCk score was 16, with higher scores representing greater knowledge.

Descriptive data (mean, 95% CI, median, interquartile range, absolute numbers, and percentages) are presented where appropriate. Owing to the nonnormality of the numerical data, Kruskal–Wallis tests were used to assess significant differences between the stakeholders and, if necessary, Mann–Whitney U tests were used to specifically determine which ones differed. For categorical data, Pearson χ^2 and odds ratios (ORs) were calculated. All analyses were conducted within SPSS v.20 (Statistical Package for Social Sciences), with a significance set at $P \leq 0.05$.

RESULTS

A total of 487 questionnaires were returned (370 players, 44 coaches, 40 medical staff, and 33 referees).

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Therefore, response rates were 58% for players, 71% for coaches, 77% for medical staff, and 100% for referees. Only one of the 12 semiprofessional teams did not return any questionnaires.

The majority of respondents across all roles were male (97%), with a high proportion (70%) of respondents having had experience at either an international or professional level of the Rugby Union (Table 1). All respondents, apart from five players (1%), had heard of the term concussion. Those who had not heard of concussion only answered the questions relating to demographics and concussion education; these participants were subsequently omitted from the analysis of CSr, personal experiences, attitudes, RTPk, and CCK.

There was a significant difference in CSr score ($\chi^2 = 8.49$, $P = 0.037$), with coaches having lower CSr scores than both medical staff ($U = 564$, $P < 0.01$) and referees ($U = 514$, $P = 0.026$) (Table 2). The mean CSr score was 18.4 (95% CI 18.2–18.6) out of 21. Respondents who had been concussed had a significantly higher CSr score than those who had never been concussed ($U = 24\,588.5$, $P = 0.044$). Players and coaches were least likely to identify “feeling in a fog” as a sign/symptom of concussion, whereas medical staff and referees were least likely to identify being “knocked-out” as a sign/symptom of concussion (Figure).

There was a significant difference in RTPk ($\chi^2 = 67.06$, $P < 0.01$), with medical staff having greater RTPk scores than both players ($U = 1647.5$, $P < 0.01$) and coaches ($U = 564$, $P < 0.01$) (Table 2). The mean RTPk was 9.4 (95% CI 9.2–9.6) out of 14. There was no difference in RTPk for respondents who had been concussed compared with those who had never been concussed. Three-quarters (74%, $n = 274$) of players identified going to the gym the next day as potentially slowing their recovery from concussion, compared with only 22% identifying doing mathematics the same day as potentially slowing their recovery.

There was a significant difference in CCK score ($\chi^2 = 81.24$, $P < 0.01$), with medical staff having greater CCK scores than players, ($U = 1666.5$, $P < 0.01$) coaches ($U = 318$, $P < 0.01$), and referees ($U = 393.5$, $P < 0.01$) (Table 2). Additionally, referees had greater CCK scores than players ($U = 3069.5$, $P < 0.01$) and coaches ($U = 458$, $P < 0.01$). The mean CCK score was 10.1 (95% CI 9.9–10.5) out of 16. There was no difference in CCK score for respondents who had been concussed compared with those who had never been concussed. Just over half of the players (55%) and coaches (52%) identified “reduced performance” as a potential risk

when returning to play concussed compared with 83% of medical staff and 70% of referees.

Sixty-two percent of respondents had suffered at least 1 concussion, with 25% sustaining three or more concussions. Of the players who had suffered a concussion (62%, $n = 228$), 59% played on and 22% reported that they felt pressure to continue to play. Eighty percent of the medical staff had felt pressured to clear a concussed player for play by either the concussed player or their coach. Additionally, 27% of referees had witnessed a coach pressure either, an apparently concussed player to play on, or medical staff to clear a player to play on. Forty-one percent of coaches had reported seeing over ten concussions, and one-third of the coaches reported witnessing other coaching staff pressure an apparently concussed player to play on.

Only 55% of the players and 61% of the coaches believed that the players who had been “knocked-out” and felt fine but showed no other signs of concussion should be removed from the field of play compared with 95% of medical staff and 85% of referees. Of the respondents, 78% of players, 98% of medical staff, 86% of coaches, and 94% of referees believed that a player should be removed from play if they have shown signs of concussion but report feeling fine.

There was a significant association between the number of concussions sustained and whether respondents believed protective equipment prevented concussion ($\chi^2 = 10.865$, $P = 0.03$). Players who had reported sustaining more than 10 concussions were less likely to believe protective equipment prevented concussion (OR 0.22, 95% CI 0.06–0.82). The majority of players (82%), coaches (66%), and referees (64%) believed that protective equipment could help to prevent concussion compared with 41% of medical staff. A head guard was the most commonly identified protection against concussion (77% players, 48% coaches, 61% referees, and 27% medical staff), followed by a mouth guard (42% players, 43% coaches, 18% referees, and 19% medical staff), and shoulder pads (7% players, 2% coaches, 3% referees, and 3% medical staff).

Ninety-three percent of medical staff had previously received concussion education through a training course, whereas only 55% of referees, 38% of players, and 34% of coaches had received concussion education. The concussion education for players and coaches was generally delivered by their medical staff and for referees was through either first-aid courses or group training.

The preferred source of concussion education for both the players (64%) and coaches (70%) was from team medical

TABLE 1. Number (%) of Respondents Categorized by Gender, Age, Years in Role, and the Highest Level in Role for Players, Medical Staff, Coaches, and Referees

Role	Gender		Age (SD)	Years in Role (SD)	Highest Level in Role		
	Male (%)	Female (%)			International (%)	Adult Professional (%)	Adult Club (%)
Player	354 (96)	16 (4)	23.9 (4.2)	13.7 (5.2)	174 (47)	93 (25)	95 (26)
Coach	42 (95)	2 (5)	37.6 (8.0)	9.1 (6.2)	18 (41)	18 (41)	8 (18)
Medical staff	27 (67)	13 (33)	34.0 (10.1)	7.6 (6.3)	7 (17)	21 (53)	12 (30)
Referee	33 (100)	0 (0)	37.4 (9.6)	10.8 (5.9)	4 (12)	8 (24)	17 (53)

NB: Highest level in role was incomplete for 8 players (2%) and 4 referees (12%).

TABLE 2. Median Values (interquartile range) for Concussion Symptom Recognition (CSr), Return to Play Guidelines and Consequences of Concussion for Players, Coaches, Medical Staff, and Referees

Role	Concussion Symptom Recognition (Maximum Score = 21)	Concussion Return to Play Guidelines Knowledge (Maximum Score = 14)	Consequences of Concussion Knowledge (Maximum Score = 16)
Players	19.0 (17.5–20.5)	9.0 (8.0–10.0)	10.0 (8.0–12.0)
Coaches	18.0 (16.5–19.5)	10.0 (8.5–11.5)	10.5 (8.5–12.5)
Medical staff	19.0 (18.5–19.5)	13.0 (12.0–11.0)	14.0 (13.0–15.0)
Referees	19.0 (18.0–20.0)	—	12.0 (10.5–13.5)

staff. Additionally, the players and coaches cited an online source (32% and 25%, respectively) or governing body Web sites (29% and 50%, respectively) as preferred sources of concussion education. Similarly, 75% of medical staff and 67% of referees cited governing body Web sites as their preferred sources of concussion education, in addition to 70% of medical staff and 61% of referees citing a training course.

DISCUSSION

This is the first article to report the levels of adult concussion knowledge and concussion experiences of players, coaches, medical staff, and referees in elite and semiprofessional Rugby Union. Medical staff generally had the best level of concussion knowledge while coaches had the worst. This is perhaps unsurprising given medical staff are engaged to evaluate and manage sports injuries and often receive information regarding concussion during training courses. However, the article also highlights that targeting the concussion knowledge and attitudes of coaches, who are highly influential to players and support staff, might be key for improving compliance with concussion management guidelines.

The results of this study indicate higher rates of concussion than previous studies of lower level and age-grade Rugby Union^{12,17} and other sports.^{11,19} Suffering

a concussion appeared to have a positive influence on individuals identifying concussion symptoms; however, this did not translate into greater knowledge of return to play guidelines or concussion consequences. Additionally, players had a similar level of knowledge to medical staff when relating to concussion symptoms, but reduced knowledge of return to play and the potential consequences of concussion. Players also associated physical exertion (“gym the next day”) as having the potential to slow their recovery from a concussion, but not cognitive exertion (“mathematics the same day”). Therefore, although players had good knowledge of concussion symptoms, they may not necessarily view it as a brain injury that requires both cognitive and physical rest.¹ If players are not monitored during their recovery, or educated about cognitive rest, they may unwittingly be at risk of hindering their recovery.

Although there was a high percentage of players and coaches who felt that players showing signs of concussion should be removed from the field of play, the same stakeholders felt that being “knocked-out” but subsequently feeling fine did not warrant a removal from play. This striking mismatch was particularly surprising as the majority of both players and coaches correctly identified this as a symptom of concussion. Also surprising was that 20% of medical staff were unable to recognize being “knocked-out” as a symptom of concussion.

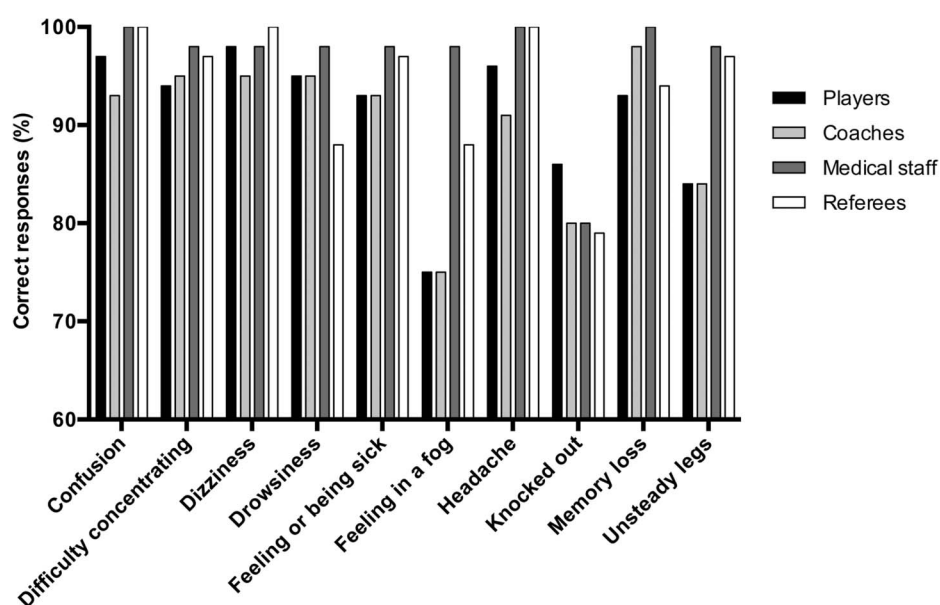


FIGURE. Proportion of players, coaches, medical staff and referees who correctly identified the true signs and symptoms of concussion.

Similar studies also report relatively high rates of players returning to play immediately after sustaining a concussion,¹⁸ in addition to coaches having limited knowledge of the signs and symptoms of concussion.¹⁹ However, the highlighted disparity between knowledge and its practical application within concussion injury is a concern. It may be possible that players readily associate “feeling fine” with the ability to continue to play rugby, which overrides their knowledge and that coaches predominantly rely on what a player says rather than precipitating factors and/or being “knocked-out.” However, when asked about a player showing other signs or symptoms of concussion, which are not accompanied by being “knocked-out” and still reporting feeling fine, the majority of both players and coaches believe such a player should be removed from play. It is evident therefore, that many players and coaches do not see a loss of consciousness as serious, but do consider concussion to be a serious injury. Addressing this misconception and disconnection between being “knocked-out,” and the symptoms of concussion should be of paramount importance within Rugby Union, especially as it may directly influence beliefs regarding removal of players from the field of play.

The management of concussion on the field of play can be particularly challenging for medical staff given the diverse range of signs and symptoms.³¹ Concussion guidelines strive to assist all stakeholders by stipulating that any player with suspected concussion should be removed from the field of play.²⁷ An apparent lack of serious physical injury, together with the negative effect on team performance when removing players with concussion,³¹ may explain why 80% of medical staff reported experiencing pressure from either players or coaches to allow a concussed player to play on. Furthermore, a small proportion of both referees and coaches had witnessed medical staff and players being pressured into allowing a player with signs of concussion to continue playing. Such pressure has previously been reported in high-school players²⁴ and may be a direct result of a player or coach’s inability to translate knowledge into appropriate practice. A way of improving translation of knowledge could be focusing education on factors important to players and coaches alike, such as performance. For example, if more coaches and players were aware that performance is likely to be negatively affected by continuing to play while concussed, coaches may be more inclined to remove that player and players may be more inclined to report their concussion.³² Education programs incorporating this message are encouraged.

A high proportion of players, coaches, medical staff, and referees still believe that equipment will protect players against concussion, even though there is a lack of evidence to support this notion.^{1,33} A similar belief has been found in other sports, such as hockey, Rugby League, and Australian football.^{22,34} Perhaps worryingly, only after 10 or more concussions were players more likely to know protective equipment could not prevent concussion. This false belief held by most respondents and players could lead to players taking greater risks during high impact collisions. Consequently, education strategies should not just target improvements in concussion knowledge but should also dispel commonly held misconceptions.

For effective concussion knowledge transfer, the most appropriate learning sources of the target audience require identification.¹ Within an elite setting, medical staff play an integral role in providing concussion knowledge for players and coaches within their respective teams. It was identified that players and coaches preferred to receive concussion education from their team medical staff, and in fact, over one-third of the players and coaches had previously been provided education from their medical staff. These findings suggest that medical staff should be encouraged to play a greater role in concussion education provided to players, coaches, and colleagues. Rugby Union governing bodies are encouraged to facilitate this by ensuring that medical staff are trained to effectively provide concussion education. Results also highlight the importance of governing body Web sites providing up-to-date, informative concussion education as all stakeholders cited this as a preferred source of information. Consequently, it is recommended that Rugby governing body Web sites have dedicated pages related to coach and player concussion education.

This study highlights the concussion experiences and knowledge of players, coaches, medical staff, and referees within elite and semiprofessional Rugby Union. As expected, the medical staff had the highest level of knowledge regarding the signs and symptoms of concussion, the return to play protocols, and the consequences of concussion. Furthermore, several role-specific misconceptions and gaps in knowledge have been identified. Additionally, medical staff should play a greater role in educating coaches and players about concussion as both stakeholders identified them as their preferred source of education.

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